

NATURAL RESOURCES CONSERVATION SERVICE

FOREST STAND IMPROVEMENT

CODE 666

DESIGN GUIDE

Forest Stand Improvement (666) shall comply with all federal state and local laws and regulations during the installation, operation, and maintenance of this practice. See Technical Guide reference – West Virginia Silvicultural Best Management Practices for controlling Soil Erosion and Sedimentation from Logging Operations

<http://www.wvforestry.com/BMP%20Book%202009.pdf>

Pesticides may be used in the installation of this practice. Note West Virginia NRCS does not make pesticide recommendations. If pesticides are to be used in the installation of this practice, recommendations for their use must be obtained from the WVU Cooperative Extension Service, the West Virginia Division of Forestry or other West Virginia certified pesticide applicator. Follow all label instructions when applying pesticides.

Destructive livestock grazing reduces the productivity health and vigor of woodlands in West Virginia. Destructive livestock grazing must be controlled. See Access Control, 472.

Specifications to Increase the quantity and quality of forest products by manipulating stand density and structure

Timber stand improvement practices are implemented to fully use the potential of a site; to maintain plant cover for soil protection; to improve stand composition by leaving the best trees, spaced for best growth; to improve the natural beauty, wildlife, or recreation values of an area.

Forest stand improvement is practiced in woodland where a stand of trees is overstocked or where desirable trees are overtopped by less desirable trees, shrubs, or vines; where removing part of a stand will improve stand quality, or the recreation, wildlife, aesthetic, or hydrologic values of an area.

Refer to soil survey interpretations for each soil series to find the site index and soils limitations for woodland.

Forest stand improvement objectives can be accomplished with any of the following practices or a combination thereof:

Area Wide Thinning – *The area wide thinning practice is a pre-commercial silvicultural treatment applied area wide in established immature stands to regulate stand density and stocking. Its purpose is to accomplish stand specific landowner objectives (primarily timber production) that can be realized by concentrating growth on trees with better form and higher potential value as a timber product. This silvicultural treatment will improve the vigor of the stand and subsequently, the health of the residual stand. The landowner can remove defective trees, limit the number of trees of undesirable species and improve the spacing of the remaining trees. The stand should have a red oak site index of at least 60 and have dominant and co- dominant trees that are at least 25 feet in height. At least 20 square feet of basal area should be removed. Crown thinning should generally be used to remove enough from other crown classes to achieve the desired basal area and stocking level. Area wide thinning should be conducted in poletimber and/or small sawtimber stands (4"– 12" diameter at breast height (DBH)).*

If a Woodland Information Stick is used, the following spacing guide provides optimum growing space after thinning sapling stands:

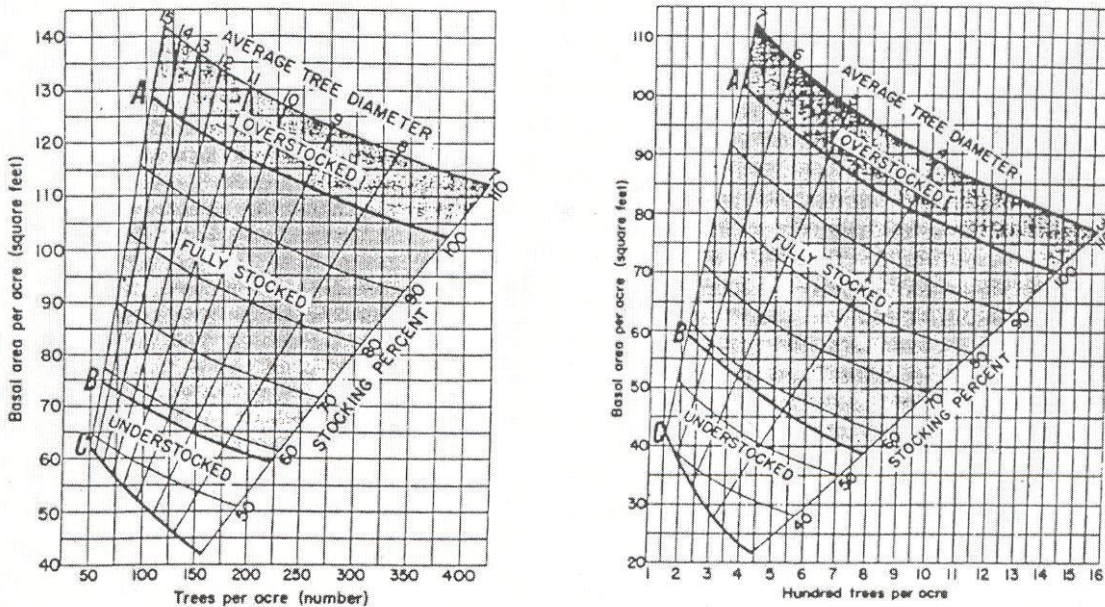
Spacing for DBH's above 5" is found on the Woodland Information Stick:

<i>Average DBH of Main Stand</i>	<i>Oak Yellow-Poplar</i>
3"	(D+5) 8'
4"	(D+6) 9'
5"	(D+7) 12'
	<i>Pines</i>
3"	(D+5) 8'
4"	(D+5) 9'
5"	(D+5) 10'
	<i>Northern Hardwoods</i>
3"	(D+4) 7'
4"	(D+5) 9'
5"	(D+6) 11'
	<i>Spruce Fir</i>
3"	(D+4) 7'
4"	(D+4) 8'
5"	(D+4) 9'

Cull Tree Removal - Cull tree removal is the practice of felling or deadening non- merchantable trees, including wolf trees, deformed trees, and weed trees for the purpose of providing room for the main crop trees to continue and increase their development of the main stand. Cull tree removal should be considered only when timber production is a primary objective.

A cull tree is any tree 4"DBH and larger that contains so little merchantable material because of rot, crook, sweep, and other defects or of inferior species that it cannot be harvested at a profit and is interfering with the development of the main stand. The purpose of cull tree removal is to provide room for the main crop trees to continue their development.

Cull tree removal is applicable in stands with a red oak site index of 60 or better having a high percentage of non- merchantable trees because of defects or undesirable species. Stands must have a minimum of 20 crop trees per acre or potential crop trees that will benefit from cull removal. For even-aged stands, cull tree removal should not reduce the stand stocking below the "B" level. See Figure 1. For uneven aged stands 50 square feet of basal area of trees 6" DBH and over should be the minimum stocking.

FIGURE 1 – Stocking Tables

SOURCE: West Virginia Forest Practice Standards, March 1972

This practice should be applied 5 or more years before or at least 2 years after a planned harvest. Culls may be cut or deadened, however, deadening is recommended if felling of trees will cause appreciable damage to residual trees. Timing of the application of cull tree deadening will influence how quickly the trees succumb to the effects of girdling.

The killing of the cull trees may be accomplished by acceptable mechanical girdling with a chainsaw. Best results are obtained by using chainsaws in accordance with the following:

For trees 6" DBH and smaller, felling using care to protect the residual stand. Stump treatment may be considered on certain sites and for certain species.

For trees 6" DBH and larger, a double cut is required at 2"-4" apart. Each cut must be at least 1" deep into the wood and must completely encircle the tree.

In some cases, trees that are to be deadened should be treated with herbicide.

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Den trees, nut trees, cull and wolf trees valuable to wildlife can be left.

Crop Tree Release - Crop tree release is a pre-commercial silvicultural treatment applied to individual crop trees in established immature stands. Crop tree management focuses on releasing individual trees that have been selected to produce benefits consistent with stand-specific objectives.

Refer to Technical Guide Reference – Crop Tree Management in Eastern Hardwoods. The purpose of

the crop tree release practice is to accomplish stand specific landowner objectives that can be realized by increasing the growth rate of individual crop trees, and improving their quality and subsequent future value as a timber product, source of scenic beauty, or source of food and/or cover for wildlife.

Crop tree release should be used in immature stands having a red oak site index of 60 or better and having dominant or co-dominant trees at least 25 feet tall. Select a maximum of 50 of the best dominant or co-dominant trees per acre. Remove all trees whose crowns are touching the crown of the selected crop tree.

Regeneration Cut – *A regeneration cut is the treatment of suitable woodland areas to encourage the natural regeneration of oak seedlings and to discourage undesirable competing vegetation. Under certain conditions this practice should be followed by a planned harvest within 5 to 10 years.*

The purpose of this practice is to reduce undesirable vegetation so as to establish a stand of oak seedlings on wooded areas as to establish and/or prepare competitive oak seedlings so that oak can be part of the regenerated stand when the stand is harvested. The purpose of this practice is to remove the mid and understory of undesirable (shade tolerant) species to encourage the production of oak seedlings and to raise them to a competitive stage so that oak can be a component of the future regenerated stand.

This practice should be implemented in presently understocked or non-stocked understories where the soils are suited to growing the desired trees for wood crops. An adequate seed source of the desired species (oaks) must be present to assume the successful regeneration of the desirable tree species.

The stand must have a red oak site index of at least 60 and have dominant and co- dominant trees at least 50 feet in height. Livestock must be excluded from the area. Oak trees must be adequately spaced within the treatment area in order to promote the production of oak seedlings. Trees must be felled or girdled and treated with an herbicide to prevent sprouting.

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Regeneration Release – *Regeneration release refers to the removal of undesirable trees from an overstory after a harvest to release hardwood regeneration in the understory. This practice would be particularly effective areas where a high grade harvest has occurred within the last 5 to 10 years and where an understory of regeneration (seedlings 3 feet or more in height) has formed.*

The purpose of this practice is to remove or kill all undesirable overstory trees where they are inhibiting the regeneration from reaching the overstory. This does not include areas where there might be a combination of higher value overstory trees and little or no advanced regeneration.

The stand must have a red oak site index of at least 60. This practice should be applied in stands where there is no more than 60 square feet of basal area. There has to be an established understory of advanced regeneration in which at least 25% of the seedlings are high quality hardwoods (oak, black cherry, cove hardwoods) by ocular estimate. All overstory trees 2 inches DBH and larger need to be girdled and/or felled and herbicide applied where necessary. Livestock must be excluded from the area.

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Combination Improvement – *Combination improvement combines the silvicultural treatments such as cull tree removal, grapevine removal and thinning in one stand area wide when no one individual*

treatment is dominant.

The purpose of a combination improvement is to remove or deaden undesirable trees and vines to provide room for the main crop trees to continue their development.

This practice is to be used in established immature stands and must have a red oak site index of at least 60 and have dominant and codominant trees at least 50 feet in height. Stands must have a minimum of 20 crop trees per acre or potential crop trees that will benefit from treatment. Livestock must be excluded from the area.

Note: West Virginia NRCS does not make pesticide recommendations. If pesticides are to be used in the installation of this practice, recommendations for their use must be obtained from the WVU Cooperative Extension Service, the West Virginia Division of Forestry or other West Virginia certified pesticide applicator. Follow all label instructions when applying pesticides.

General Forest Stand Improvement Guidelines for Timber Types

In those instances where the landowner wants to culture his forest before the trees are merchantable, the following forest types lend themselves to the some or all of the forest stand improvement practices discussed above:

OAK-HICKORY

On good sites (site index 60 or greater), pre-commercial thinnings of stands 10 to 20 years old can often be justified by rapid growth of high-value trees, even if there is no market for the trees that are taken out. On poor sites (site index less than 60) this is seldom true. Thinnings are acceptable in young oak-hickory stands to free oaks and other desired species from unwanted competing trees and grapevines.

NORTHERN HARDWOODS *Pre-commercial stand treatment may be necessary to preserve an acceptable species composition in young even-aged stands. Thinnings in intermediate size classes maintains individual tree growth rates, reduces cull, harvests mortality, and upgrades the quality of even-aged stands.*

ELM - ASH - COTTONWOOD (Bottomland Hardwoods)

A fully stocked immature stand requires tending throughout its life. Even before trees become merchantable, thinning will be needed to concentrate growth on the most desirable trees. Trees likely to be culls, slow growers, or of little commercial value (Hackberry, River Birch, and American Elm) should be removed. The goal is to attain a stand of approximately 50 high quality trees per acre at final harvest.

OAK-PINE

A high percentage of the oak-pine forest is in poor condition and has low stocking in trees that could be featured in management. Improvement cuttings when combined with group selection of one-half acre or more in size can effectively rehabilitate depleted oak pine stands. Favor better quality hardwoods on good sites and yellow poplar with pines where possible. Expanded markets for low value hardwoods enhance the ability to make improvement cuts. Select trees to favor from dominate or co-dominants of desirable species with good stem and crown form and reasonably free of defect.

WHITE PINE

Seedling Stage - *Where oak site index is over 60, weed out hardwoods in areas where white pine is most abundant. In areas where this group arrangement does not develop naturally, manage for hardwoods. Where site index for oak is less than 60 remove the hardwoods that are interfering with the height growth of the pine. Release on an individual tree basis or by group. If less than 50 percent of the area is stocked with white pine, manage for hardwoods.*

Sapling Stage - *If more than 50 percent of the stand is stocked with white pine free to grow release at least 60 well distributed trees per acre. If 50 percent of the stand is stocked with white pine not free to*

grow, weed out hardwoods where there are natural groups of pine. If 50 percent of the stand is stocked with white pine not free to grow and on an oak site index of less than 60 release 200 white pine trees per acre by removing hardwood overstory. If less than 50 percent of the stand is stocked with white pine, manage for hardwoods.

White Pine Poles - Where hardwood site index is 60 or greater apply a commercial thinning if possible but if not apply a noncommercial thinning where stocking is too dense. If hardwoods are beginning to overtop, thin hardwoods to release 150 to 200 white pines per acre. If stocking of white pine is low, favor hardwoods but release white pine crop trees. When the hardwood site index is less than 60, release white pine. If white pine stocking is less than 200 trees per acre do nothing unless timber stand improvement will release 100 white pine crop trees-per acre.

RED SPRUCE

Intermediate Cuttings - The initial operations in uneven-aged stands to be managed by the selection system are usually salvage cutting, and thinnings. The object is to rid the stand of over mature trees of poor vigor, rough or rotten trees, and trees of undesirable species. Deadening of completely unmerchantable trees is also silviculturally desirable. Thereafter, harvesting and improvement cutting are part of the same operation. Even-aged stands of spruce need early thinning to reduce density. A pre-commercial thinning can be combined with a cleaning when trees are 6 to 15 feet tall.

VIRGINIA PINE

Intermediate Cuttings - Regulate stand density before stand is 12 to 15 years old. Do not make later thinnings.

YELLOW POPLAR

In the seedling and sapling stages, dominant and co-dominant trees are little affected by thinning. Removal of vines is recommended. Commercial thinnings should be made when the stand is 20 to 30 years of age and continued until at least age 80.

Additional Specifications to Harvest Forest Products in Timely Manner

Improved forest harvesting is practiced by systematically removing some of the merchantable trees from an immature stand or all the trees from a designated part of woodland. Some of the merchantable trees from an immature stand are harvested to improve the conditions for forest growth and/or to harvest trees to encourage regeneration and normal development of a new stand.

Improved woodland harvesting is practiced in areas where the site, size, species, and density of a forest stand make the planned and systematic harvesting of forest trees economically and silviculturally feasible for improving the growth of the remaining trees or for regenerating the stand. The silvicultural systems that will normally provide the best results are included for each forest type. A forest harvest planned and supervised by a professional forester is acceptable. See West Virginia Standard Forest Trails and Landings - Code 655 when planning a road/trail system.

Comply with all federal state and local laws and regulations during the installation, operation, and maintenance of this practice. See Technical Guide reference – West Virginia Silvicultural Best Management Practices for controlling Soil Erosion and Sedimentation from Logging Operations

<http://www.wvforestry.com/BMP%20Book%20Comple e.pdf>

OAK-HICKORY

Species to favor: Northern red oak, white oak, yellow poplar, black oak, scarlet oak, black cherry, white ash, red maple, basswood. Intermediate cuttings should be started early (10 to 20 years of age), and followed by periodic thinnings at about 10-year intervals.

See Table 1 below. Rotation lengths can be shortened if stands are thinned early and regularly. The approximate time between cuts is:

Table 1

Stand Age	Site Index	Years to Grow 2" DBH
30-60	< 55	13 - 18
30-60	55 -65	11- 15
30-60	65-75	10 - 13
30-60	75 - 85	8 - 11
30-60	85 >	7 - 9

Stocking and Spacing: See thinning guide on woodland information stick for spacing of oak/yellow poplar.

Site Quality: See Table 2

Table 2

Site Index Class (Feet)	Sawtimber Rotation Length (Years)	Crop Tree Diameter (Inches)	Pulpwood Rotation Length (Years)
75>	60-75	24-28	40-50
55-74	75-90	20-24	50-60
40-54	90-120	16-18	60-80

Final Harvest: Clearcuts of one acre or larger are appropriate when adequate oak and hickory reproduction is present. Harvest or cut all trees to about 2" DBH to release seedlings beneath. Shelterwood or diameter limit cut is appropriate when oak and hickory reproduction is not adequate.

NORTHERN HARDWOODS

Species to Favor: Maples, white ash, birches, white pine, northern red oak, black cherry, beech, hemlock. (Species to favor depends on the cutting system being used.)

Intermediate Cutting: Start at age 45 to 50 and follow with periodic thinnings at about 10 to 20-year intervals. (See Table 1 for oak/hickory type, above.) Stocking and Spacing see thinning guide on woodland information stick for proper spacing of Northern Hardwoods.

Site Quality: See Table 2 for oak/hickory type (above)

Final Harvest: Use any silvicultural system except the seed-tree.

OAK-PINE Species to Favor:

Site Index	Species
< 65	Pine
> 65	Oak, Yellow Poplar

Intermediate Cuttings: Thinnings should start as soon as trees to be cut are ready for pulpwood. Combine with group selection cuts of 1/2 acre or more. - See Table 1 for oak/hickory type.

Stocking and Spacing: See thinning guide on Woodland information stick for proper spacing of northern hardwoods.

Site Quality: See Table 2 (above)

Final Harvest: Clearcutting followed by site preparation, hardwood control, and seeding or planting has been most effective. Group selection and a combination of intermediate cuttings may be used. Single tree selection is not recommended because it discriminates sharply against the more light demanding species.

ELM-ASH-COTTONWOOD (Bottomland Hardwoods)

Species to Favor: Sycamore, sweet gum, red maple, oaks, hickories, and American beech. Most desirable bottomland hardwoods are intolerant or moderately tolerant of shade.

Intermediate Cuttings: In even-aged stands, start when trees reach 8 to 10 inches in diameter. In unevenaged stands remove scattered overmature, damaged, and dying trees. Stocking and Spacing: See thinning guide for oak/yellow poplar on the woodland information stick for spacing.

Site Quality:

Site Index	Final Harvest Tree Diameter
>70	24" - 26"
<70	Manage for uses other than timber.

Final Harvest: Clearcut and take what regeneration comes is an ideal way to start a fine crop of new trees. Leave only dead snags for cavity nesting birds. A light shelterwood cut about 10 years before final harvest will regenerate adequate seedlings if they are not present. The single tree and group selection are not recommended because they result in too many shade tolerant tree species. The seed-tree system is seldom successful because of the conditions necessary to establish new seedlings.

WHITE PINE

Species to Favor:

Oak Site Index Species

> 70	Oak - Favor high value hardwoods
60 - 69	Best suited for mixtures of Pine and hardwoods
< 60	Best suited for growing White Pine

Intermediate Cuttings:

1. Oak site index over 60 and where 50 percent of stand basal area is white pine - strive to develop a mixed stand of hardwood and white pine. Weed out hardwoods where white pine reproduction is most abundant. Where stand basal area is less than 50percent white pine, manage for hardwoods.

2. Site index for oak is less than 59 - remove the hardwoods that are interfering with the height growth of the pines or those that are interfering directly with the amount of light that reaches the pine. Release should be on an individual-tree basis or by group where groups are present. Hardwoods that are not competing should be retained in the stand. Re-examine the area in 5 years.

Stocking and Spacing: See thinning guide on woodland information stick for proper spacing of pine.

Site Quality:

Site Index	Final Harvest
	Mean Stand Diameter Inches
60 or less	12 - 14
65 or greater	16 - 18

Final Harvest: Use a two-cut shelterwood system to regenerate white pine. Make first cut after an abundant seed year: remove 40 to 60 percent of the overstory; expose mineral soil so pine can germinate. Remove the shelter trees after newly established seedlings are growing rapidly. (Usually after 5 to 10 years). In the low site oak stands clearcutting should be used.

RED SPRUCE

Species to Favor: Favor spruce over (beech, birches, and maple) hardwoods on typical spruce soils. If the objective is to produce sawlogs and veneer logs, favor hardwoods.

Intermediate Cuttings: Begin at 25 years with periodic thinnings at 10 to 20 year intervals and thereafter.

Stocking and Spacing: See thinning guide for spruce/fir on the woodland information stick for proper spacing.

Site Quality:

Site Index (Feet)	Cords at Ages		
	50	70	100
30	11	18	21
40	20	32	37
50	27	44	51
60	35	55	64
70	42	66	77

Final Harvest

1. *Selective cutting (uneven-aged stands)*
 - a. Remove mature trees as scattered individuals or smaller groups at 10 to 15 year intervals.
 - b. Cut trees according to the following priority:
 - poor quality trees
 - slow growing trees
 - less desirable species
 - trees that will influence space for crop trees
 - c. Favor high vigor, dominant trees that grow an average of more than one inch in diameter over a 10-year period.
2. *Clearcutting (even-aged stands)*
 - a. Cut all trees down to 2 inches in diameter, if advance reproduction is present, or good seed source is available or planting is planned.
 - b. Cut in progressive strips or patches no more than 400 feet wide.
 - c. On hot, dry sites and where windthrow is a hazard, narrow strips or small patches of a width not exceeding half the height of the trees being harvested is necessary to protect the residual stand.
3. If a shelterwood cutting is used, the first harvest cut should take no more than one-half of the basal area and the cut should be uniformly distributed. The second cut should be made when the reproduction is well established.

VIRGINIA PINE

Species to favor: Virginia, shortleaf and pitch pine

Intermediate Cuttings: Intermediate thinnings are not recommended because there is little response of released trees except very early in the life of the stand. If early thinnings are made at 5 - 15 years of age, no usable product is obtained to pay for the work and the density of the stand is reduced so that hardwoods are encouraged.

Stocking and Spacing: Thinnings are not recommended

Site Quality - See Table 3

Table 3

Site Index (Feet)	Rotation Length (Years)	Cords (Per acre)
80	30	38
70	30	22
60	30	13
55	30	

Final Harvest: Some form of clear-cutting with provision for re-seeding and hardwood control appears to be the most practical way of harvesting Virginia pine. This may be done in any one or a combination of the following ways:

1. Cutting in uniform width strips (100'-200') at right angles to prevailing winds, starting on the lee side of a block. When reproduction is started on the cut-over area, the next strip can be removed, progressing

across the area until the last strip is ready to cut. The last strip should be cut in the winter following a good seed year.

2. Another variation is to cut every other strip in a pine area in one year. The remaining strips are cut in the winter following a good seed year after reproduction is established on the first cut strips. This system increases the hazard from storm damage.

3. Clear-cutting may also be done in small 1/2 to 1 acre blocks where a good seed source is left adjacent to the cut area.

4. An entire area may be clear-cut if it is done during the winter following a good seed year. However, this method increases the hazard of getting inadequate reproduction.

YELLOW POPLAR

Species to favor: Black locust, eastern white pine, eastern hemlock, hickories, northern red oak, white ash, black cherry, yellow birch. The percentage of yellow poplar usually increases with the increasing quality of the site.

Intermediate cuttings: The first commercial thinnings may be feasible when stands are 15 to 20 years old, especially on high site- quality land. **Stocking and Spacing:** See thinning guide on woodland information stick for spacing oak/yellow poplar.

Site Quality:

Site Index (Feet)	Rotation Length Minimum (Years)
60	70
70	70
80	60
90	60
100	50
110	45

Final Harvest: Clearcutting, shelterwood, or small patch clearcut will be sufficient to insure establishment of yellow-poplar regeneration. Clearcuts should be one acre or more.

Non-timber Forest Products

When production of non-timber forest products is also a landowner objective, the following should be noted: Both ginseng and goldenseal require 70 to 80 percent shade over most soil types. Additional information on the cultivation of woods grown ginseng is available on West Virginia University Cooperative Extension Internet site:

www.wvu.edu/users/agexten/www/fldcrps/ginseng.htm

Additional information is also available at the following National Agroforestry Center Internet site: <http://www.unl.edu/nac/afnotes/>

Logs harvested for the production of exotic mushrooms should be cut during the dormant season when the sap is running in the

Tree and contains the maximum amount of stored carbohydrates - either late fall when sap is moving down into the roots, or in late winter / early spring when it begins to move up to the crown again, roughly Thanksgiving to Saint Patrick's Day. During cutting, it is important to minimize damage to the bark layer. Logs should be cut no more than a few days before inoculating, and the trees from which the logs are cut should be alive at the time of cutting. Recommended log diameters are three to eight inches;

recommended lengths two to four feet. Logs smaller than three inches in diameter can dry out very quickly; logs greater than six inches can produce mushrooms over a longer period of time but require more inoculation site per log to compensate for the greater diameter. Oaks have proven to be some of the most productive species of exotic mushrooms, and a wide variety of other hardwood species are also acceptable.

Additional Specifications to Improve Wildlife Habitat

Manage for a variety of native tree species and stocking rates that meet desired wildlife and pollinator species food and cover requirements.

Create, recruit and maintain sufficient snags and down woody material to meet requirements of desired species and secondary cavity nesting species in balance with conditions needed to achieve other intended purposes.

Often times the creation of snags, den trees and downed wood is desired. The following information is associated with these wildlife habitat elements:

The manageable forest must be mid to late successional, with trees commonly larger than the minimum pole size; approximately 6 inch diameter at breast height (DBH).

Definitions

Snag – Includes standing dead or partially dead trees which are at least 6 inches diameter at breast height (dbh) and 20 feet tall. (“Stub” if shorter).

Den Tree – A live or dead tree of any diameter containing a natural cavity or exfoliating bark used by wildlife for nesting, brood rearing, hibernating, roosting, daily or seasonal shelter and escape.

Mast Tree – Species which provide seeds/nuts and fruits. While almost all trees produce fruits or seeds used by wildlife for food, there are some species in West Virginia that are especially important. They include oaks, beech, black cherry, and hickories.

Nest Tree – Trees containing large nests built by crows and hawks that resemble a platform of sticks from the ground (2-3 feet diameter). These may be used by owls or re-used by hawks.

Coarse Woody Debris or “Downed Wood” – Live or dead woody on the forest floor that is at least 4 inches in diameter and 6 feet in length.

Girdling - the removal of bark and cambium from the target tree through the use of cuts that encircle the entire tree. Girdling destroys the cambium so no growth can occur and disrupts the flow of water and nutrients in the tree. To girdle a tree, remove a band of wood and bark all the way around the trunk. The band should include at least one-half inch of wood and be about two inches wide, if done with an axe. Girdling can also be done with a chainsaw: two encircling cuts will be required, to a depth of one to two inches.

Snag Creation / Maintenance (per acre) - Emphasis should be given to tall trees with large diameter as these provide the greatest amount of available habitat to the greatest number of species.

Minimum average number – 3-5 per acre. Minimum tree size 6 inch DBH, with at least one per acre 15 inch or larger DBH.

Canopy trees preferable, but at least 10 feet tall.

Snag trees should be as evenly distributed throughout the stand as possible.

Snags should be created from low quality hardwood or pine, not considered to be a significant mast producer or having timber value. Tree species to favor / select: elm, maple, birch, yellow poplar, Virginia pine, American sycamore, cottonwood, hackberry, cedar

Snags can be created by “girdling” select trees with an ax or chain saw. See definition below.

Do not girdle live den or nest trees or trees that are currently providing important mast (food) such as American beech, hickory and oak trees.

Den Tree Maintenance/Creation (per acre)

Minimum average number – 5-7 per acre. Maintain all existing den, nest and cavity trees.

Retain cull trees of various diameters. Protect larger trees to extent possible. Maintain distribution throughout the stand as evenly as possible.

Manage forest so that some large trees are maintained past the rotation age. These large trees will provide the best potential nest and den trees. Den trees can be encouraged through crop. tree/mast tree release which provides accelerated canopy expansion and development. The large branches that are favored with this practice may develop into suitable cavities for wildlife.

Future den trees can be created by wounding selected trees that are at least 100 feet apart, and preferably ones that show signs of damage or decay. A cavity may take years to develop.

Consider American beech, ash, elm, cottonwood, American sycamore, maple, and basswood for any of the methods below:

- 1. Cut a limb, at least 10 feet off the ground (larger the better) about 6 inches from the trunk of the tree.*
- 2. Chop out a 6"x 6" section of bark on the trunk at least 10 feet off the ground.*
- 3. Drill a hole at least two (2) inches in diameter and three (3) inches deep. The hole should be under a limb that is three (3) inches or more in diameter if possible.*

Downed Wood (Coarse Woody Debris) Creation / Maintenance (per acre)

Minimum average number of logs – 1-3 per acre.

Logs must be at least 10 inches at the large end and 30 foot long to be considered coarse woody debris.

Significant number of felled logs should be near toe slopes, bottoms and non- southern aspects.

Emphasis should be given to tall trees with large diameter as these provide the greatest amount of available habitat to the greatest number of species. Do not fell snags, live den or nest trees or trees that are providing important mast (food) such as American beech, hickory and oak trees.

Minimize improvement actions that disturb seasonal wildlife activities.

Refer to Early Successional Habitat Development/Management (647), Rare and Declining Habitats (643), Upland Wildlife Habitat Management (645), and Wetland Wildlife Habitat Management (644) to further develop and manage wildlife-related activities.

Additional Specifications to Provide Wildlife Food and Cover

Establish plant species that provide wildlife food and cover for the target wildlife species and/or pollinator habitat.

Habitat requirements for terrestrial wildlife and important plant species may be found in the West Virginia Wildlife Habitat Evaluation Technique (WVWHET).

For pollinator habitat refer to the plant species and habitat assessments located in the West Virginia Pollinator Handbook.

Vegetative successional state shall be maintained to accommodate target wildlife species requirements.

When wildlife and/or pollinators are a concern, a lower percent groundcover than would be needed if protecting soil and water quality was the only goal is acceptable as long as the soil resource concern is also adequately addressed (i.e. no excessive soil loss). This may be achieved by simply increasing the field border width.

Schedule mowing, harvest, and weed control activities within the field border to accommodate reproduction and other life cycle requirements of target wildlife species.

Timber harvests can be planned to provide early successional habitat. The methods described above to construct openings or maintain existing openings in forested areas, may also be utilized where timber production is an objective. The type of forest stands, their age class, and how they are arranged determines the species of wildlife that benefit. The WV Division of Forestry should be consulted to coordinate these methods with timber production.

Early successional habitat can be created in the form of cutback borders (edge feathering) and forest openings. See Early Successional Habitat Development/Management – Code 647.

Forest Stand Improvement for Pollinators

Forest stands are appropriate places to develop pollinator habitats. Desirable species should be maintained that encourage use by pollinators and bloom throughout as much of the season as possible. Since trees and shrubs typically are available prior to the bloom period of most herbaceous plants, they are often the most visited of plants by bees early in the season. Conversely, woody species stop blooming earlier in the growing season and the floral resources are not available throughout the growing season. Therefore, it is not advisable to depend solely upon woody species to provide pollinator resources. For this reason, it is acceptable when installing exclusively woody species enhancements to utilize bloom periods of very early, early and mid-season.

A woody pollinator mix must contain at least three species in each of the three blooming periods as discussed above (very early, early and mid). Trees and shrubs should be maintained at a close spacing to aid in pollinator access but also allow for maximum crown development and bloom.

See the West Virginia Pollinator handbook for a listing of trees and shrubs that benefit pollinators when choosing species to maintain during forest stand improvement activities.

Woody pollinator areas greater than one-half acre (0.5 acres) in size are exponentially more beneficial.

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